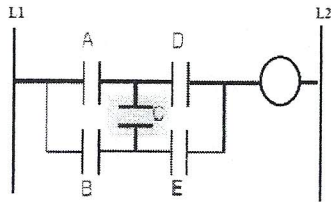


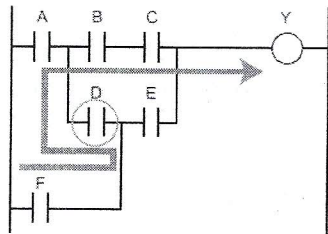
## Sheet (4)

### 1- Explain Ladder Diagram Programming Restrictions.

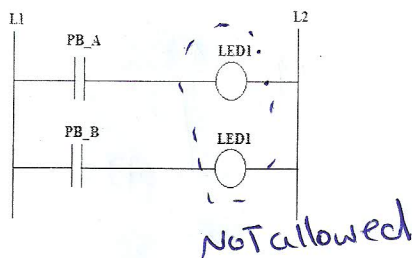
- 1) Vertical contacts are not allowed.



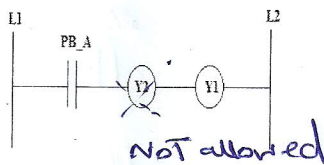
- 2) Power can never flow from right to left.



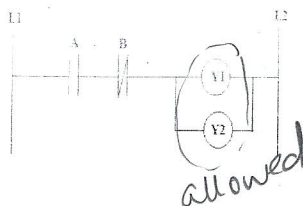
- 3) An output referencing a specific real output should appear only once in ladder diagram



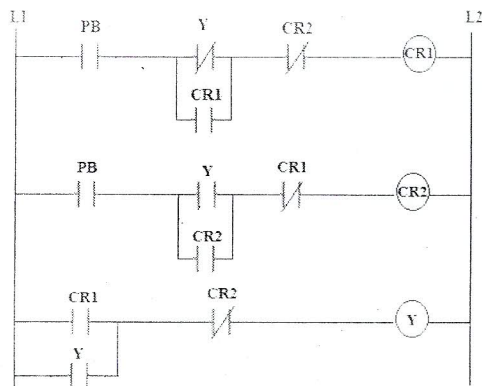
- 4) Only one output should appear in a rung of ladder diagram



- 5) If more than one output is to be controlled by a certain rung of ladder diagram, these outputs can be placed in parallel.



- 2- Explain with ladder diagram how the push button switch can be used as a toggle switch with two functions: on and off.

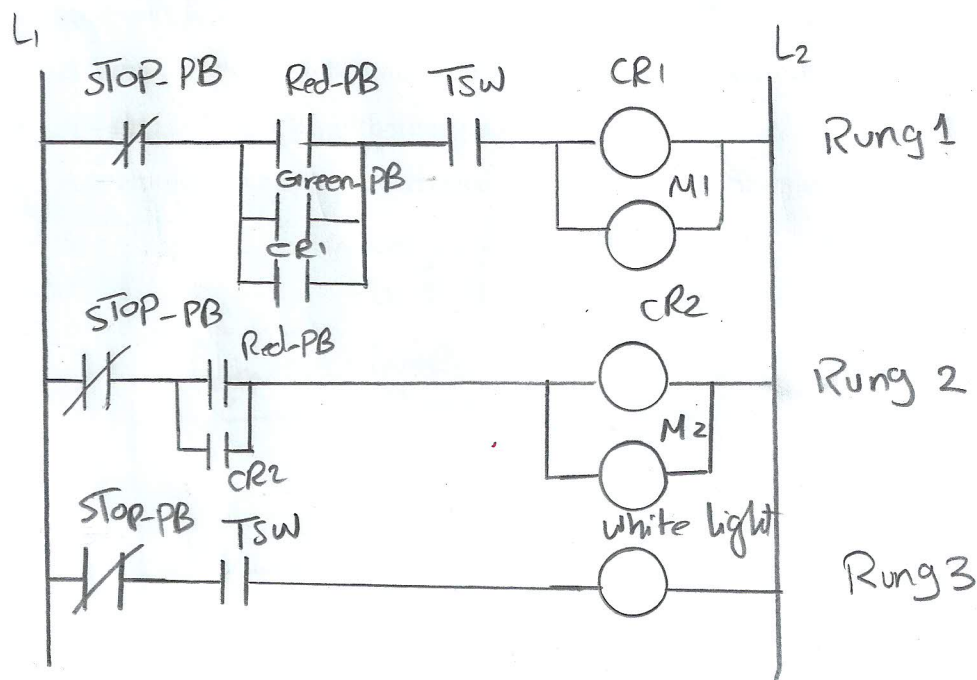
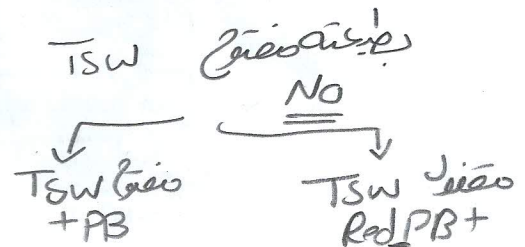


- 3- Draw Ladder Diagram for the following operation:

In a motor

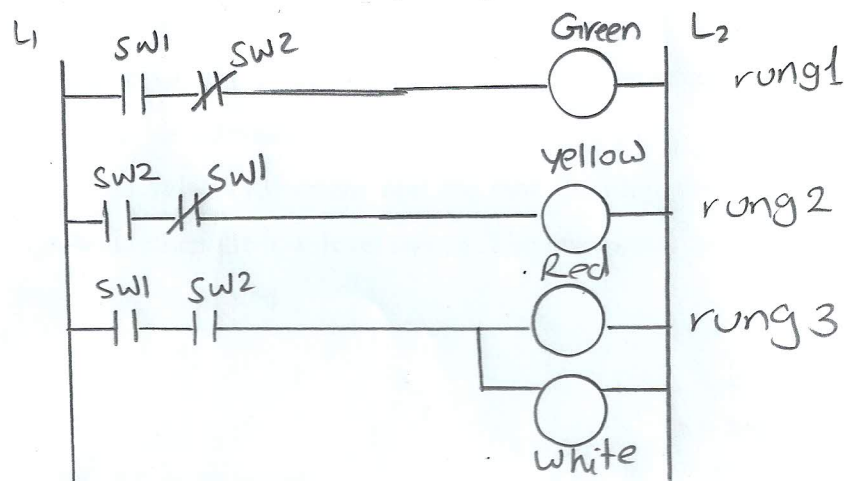
control system, one master stop pushbutton (Stop-PB) is available for stopping the operation at any time. If the temperature switch (TSW) is closed, pressing the red pushbutton (Red-PB) will turn on both motor one (M1) and two (M2). If TSW is open, pressing Red-PB will only turn on M2. If TSW is closed and the green pushbutton (Green-PB) is depressed once, M1 will run. Closing the temperature switch turns on the white pilot light.

TSW + Red-PB  $\Rightarrow$  M1 & M2  
 Red-PB  $\Rightarrow$  M2  
 TSW + Green-PB  $\Rightarrow$  M1  
 TSW  $\Rightarrow$  white light



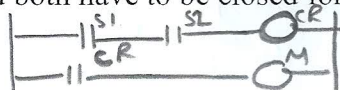
4- Draw the Ladder diagram for the following operations:

- When switch one (SW1) is closed, the green pilot light turns on.
- When switch two (SW2) is closed, the yellow pilot light turns on.
- When both SW1 and SW2 are closed, the green and yellow pilot lights turn off, and the red and white pilot lights turn on.

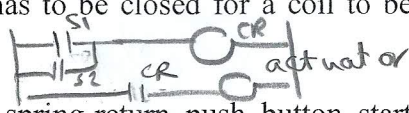


5- Draw the ladder diagram to represent the following operations:

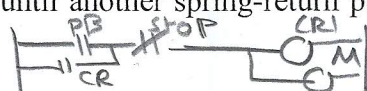
- Two switches are normally open and both have to be closed for a motor to operate.



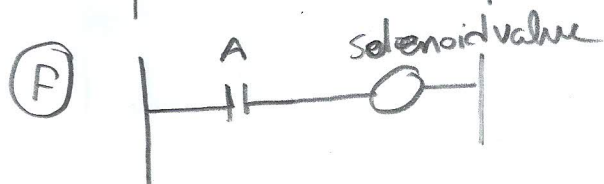
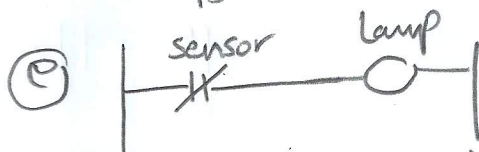
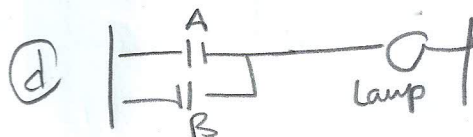
- Either of two, normally open, switches has to be closed for a coil to be energized and operate an actuator.



- A motor is switched on by pressing a spring-return push button start switch, and the motor remains on until another spring-return push button stop switch is pressed.



- A lamp is to be switched on if there is an input from sensor A or sensor B.
- A light is to come on if there is no input to a sensor.
- A solenoid valve is to be activated if sensor A gives an input.



Report

6- Draw the Ladder diagram for the following **Steam Cooker** application:

- The start button (x4) is momentarily closed, starting the pump (y1).
- The tank fills, activating first the low-level sensor (x3), then the high-level sensor (x1).
- Then the pump stops.
- The steam valve (y2) opens, raising the temperature until the temperature switch (x2) is activated.
- The drain valve (y3) opens and the tank empties, de-activating first the high-level, then the low-level sensor. Then the drain valve closes.
- Steps a-e are repeated.

